

Triple junction

Objective :

- To know what is triple junction.
- To learn more about structure formed by triple junction.
- Relating triple junction with continental plate rifting.

:Introduction

Earth's crust and upper mantle (lithosphere) consist of moving pieces (plates) lying above a weaker semi plastic .asthenosphere

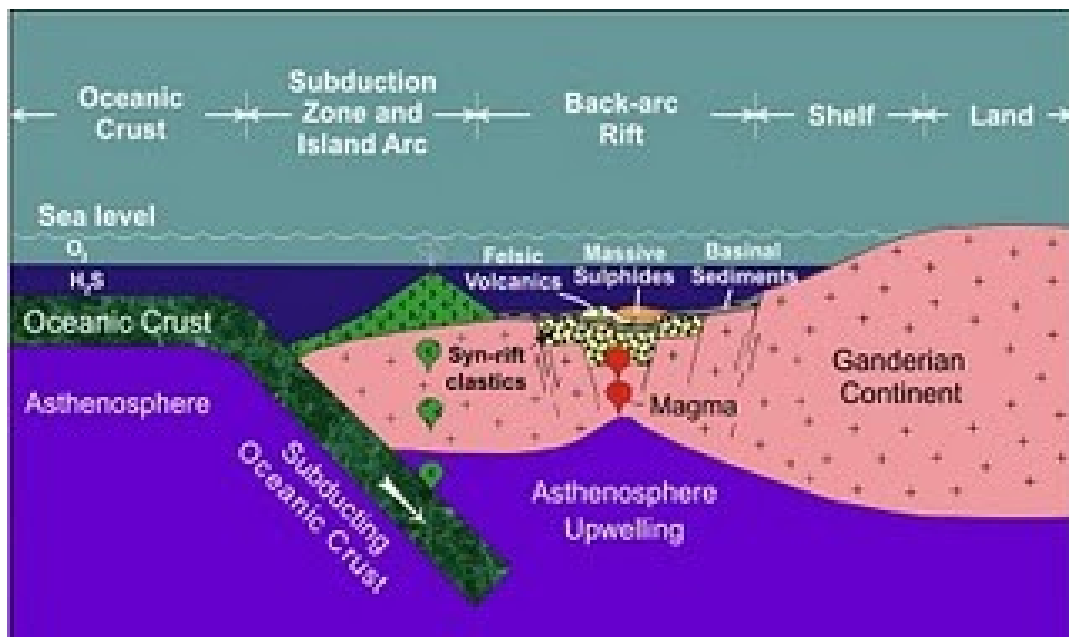
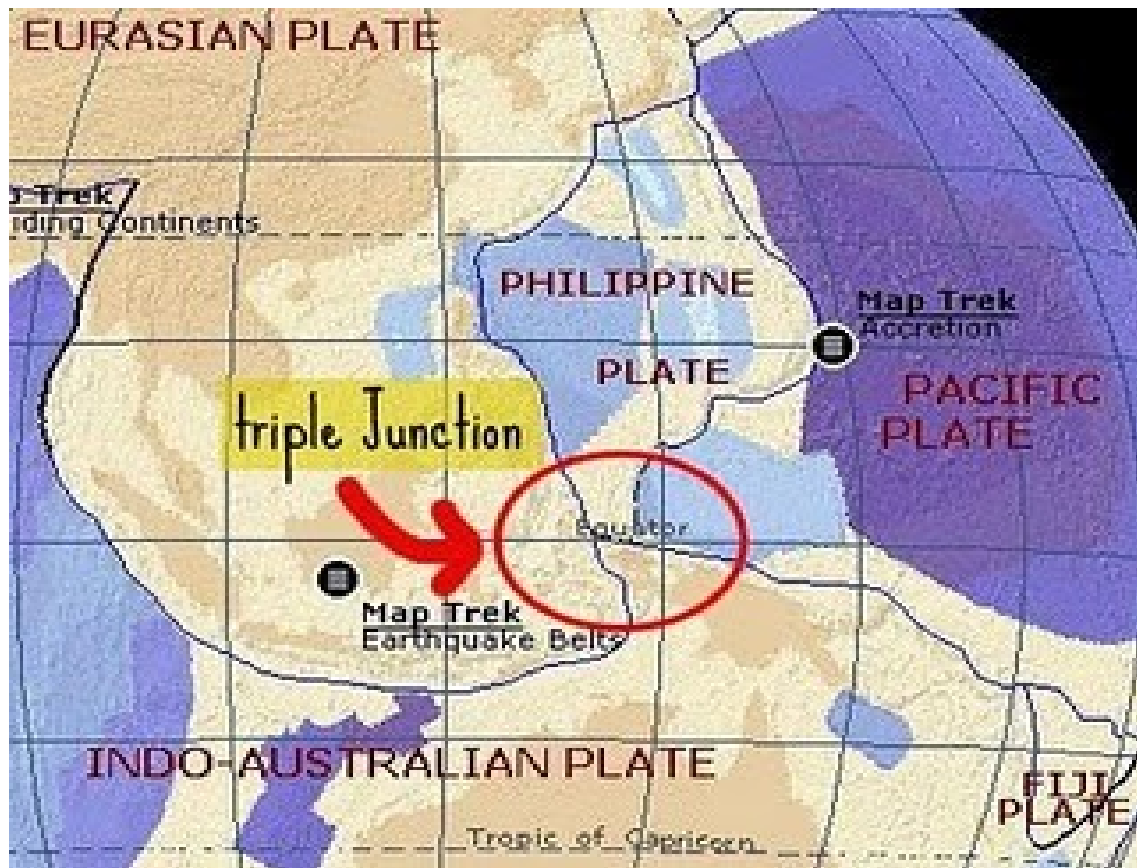


Plate tectonics provides a convincing explanation for such phenomena as continental drift, earthquake activity, and the formation of mountain ranges and of chains of .volcanoes

It does not appear to have played a significant role in the development of any other planet in the solar system, although the Tharsis Region on Mars shows evidence of embryonic but stalled plate activity

The remarkable notion that the continents have been constantly broken apart and reassembled throughout Earth's history is now widely accepted. The greatest revolution in 20th century understanding of how our planet works, known as **plate tectonics**, happened in the 1960s, and has been so profound that it can be likened to the huge advances in physics that followed Einstein's theory of relativity. According to the theory of plate tectonics, the Earth's surface is divided into rigid plates of continental and oceanic lithosphere that, through time, move relative to each other, and which increase or decrease in area

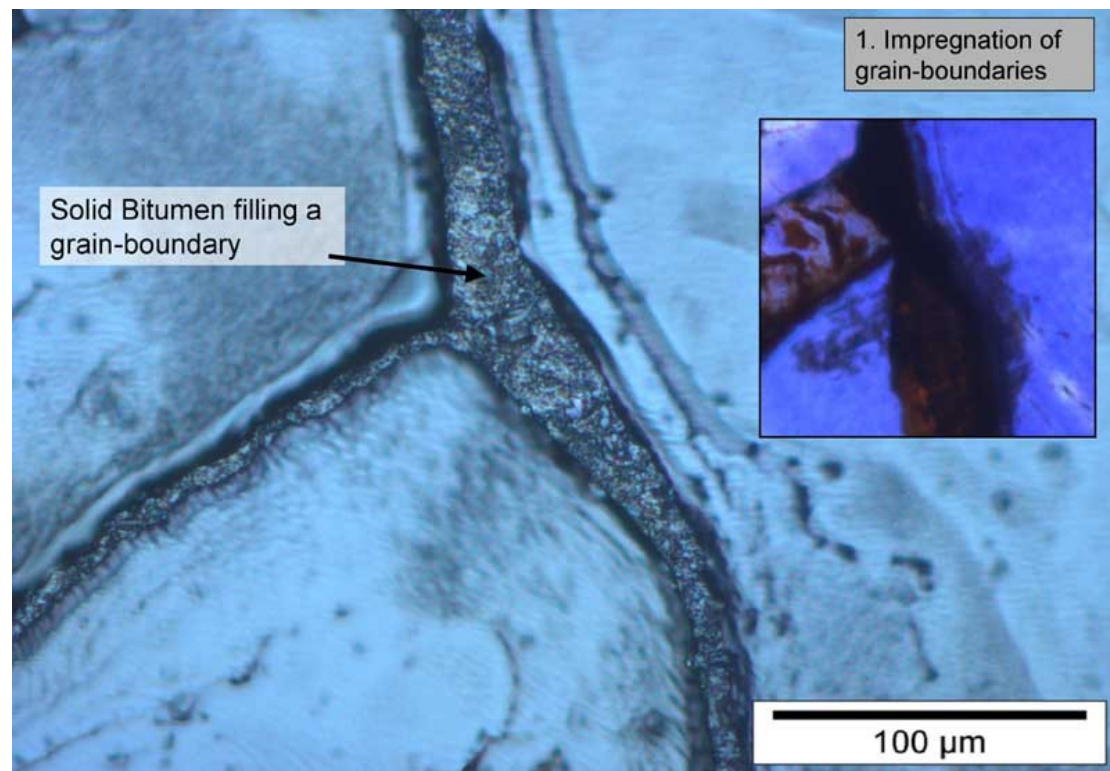
plate tectonics the breakup of a continent, one of the divergent plate boundaries would fail and the other two would continue spreading to form an ocean. The opening of the south Atlantic Ocean started at the south of the South American and African continents, reaching a **triple junction** in the present Gulf of Guinea, from where it continued to the west. The NE-trending Benue Trough is the failed arm of this junction, Here where the triple junction exists



Triple junction: A triple junction is the point where the boundaries between three tectonic plates, and three plate margins, meet. At the triple junction a boundary will be one of 3 types - a ridge, trench or transform fault. Of the many possible types of triple junction only a few are stable through time. The properties of triple junctions are most easily understood from the purely kinematic point of view where the plates are rigid and moving over the surface of the Earth. No knowledge of the Earth's interior or the geological details of the crust are then needed. Another useful simplification is that the kinematics of triple junctions on a flat Earth are essentially the same as those on the surface of a sphere despite describing plate motions as involving relative rotations about poles and plate motions on a flat surface being defined by vectors. The relative motions at the triple junction are the same, and it's divided into two types

Stable, if the configuration does not change with time.
N.B. this does not necessarily mean that the point itself does not move relative to some other point

.Unstable, if the configuration changes



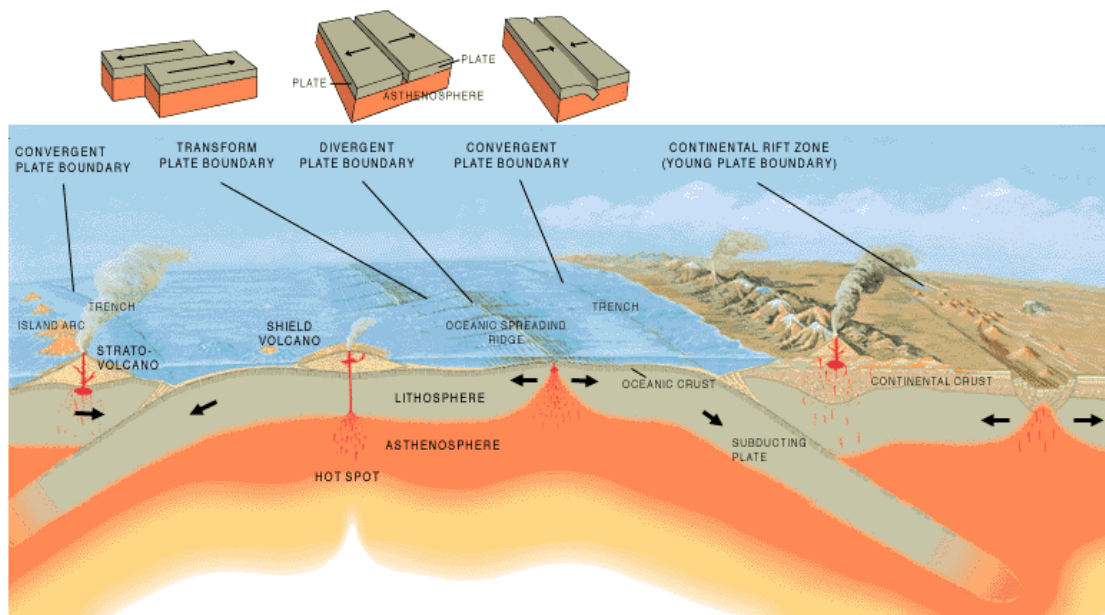
We could possibly consider higher order junctions as well, however these can be proven to all be unstable, except for the case of two divergent boundaries located along a line, with different spreading rates, hence separated by two conservative boundaries, For a convergent boundary it holds that the boundary does not move relative to the over-riding plate. This holds for every point on the over-riding plate parallel to the boundary. We then mark the line of consistency in our velocity triangle as a dashed line passing through the plates location and parallel to the .strike of boundary

The Afar Triple Junction is a junction of three tectonic rifts ridges centered in the Afar Depression of northeastern Africa. Here, the Red Sea Rift meets the Aden Ridge and

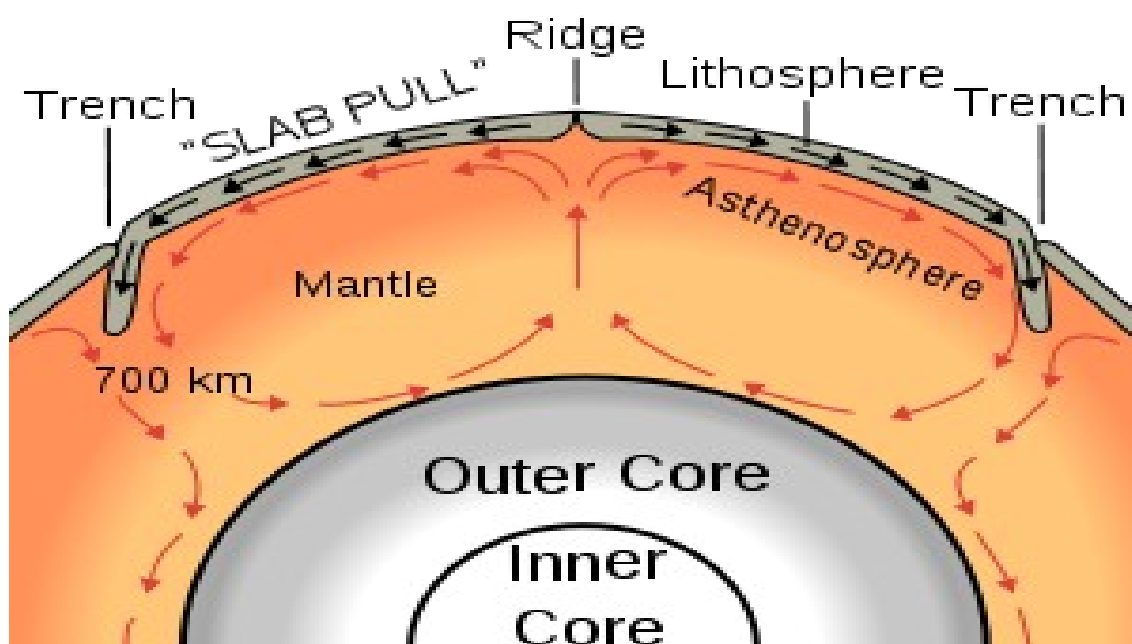
the East African Rift. It also represents the junction of the Arabian Plate and the two protoplast which are beginning to form as the African Plate splits apart along the East African Rift. These protoplasts, or sub plates, are referred to as the Nubian and the Somalian Plates



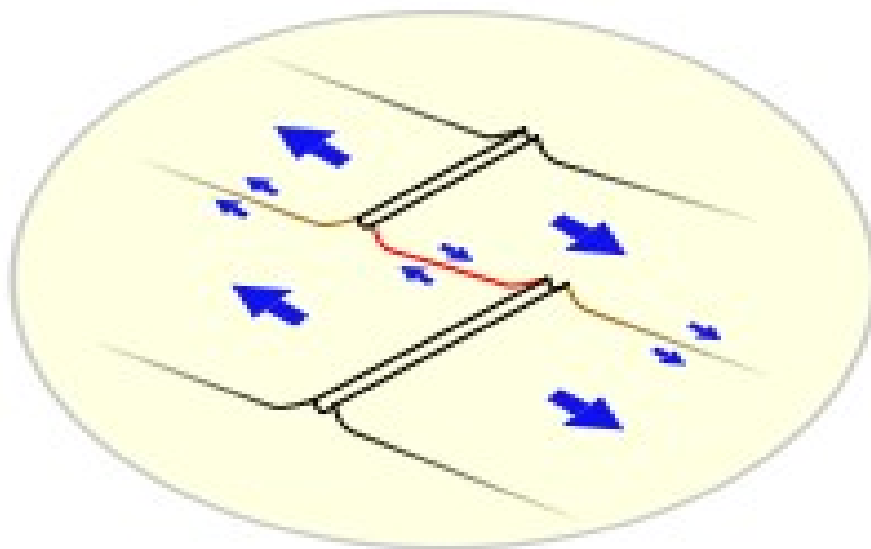
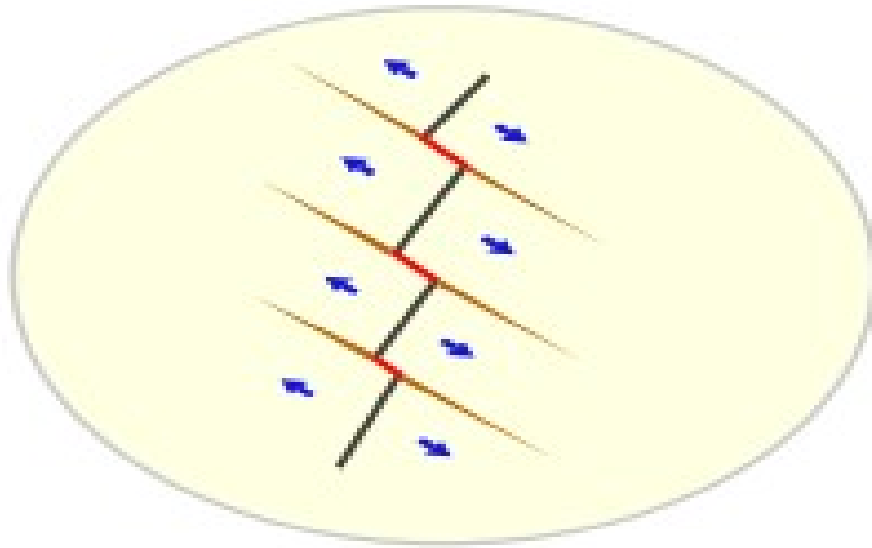
mid-ocean ridge is a general term for an underwater mountain system that consists of various mountain ranges (chains), typically having a valley known as a rift running along its spine, formed by plate tectonics. This type of oceanic ridge is characteristic of what is known as an oceanic spreading center, which is responsible for seafloor spreading



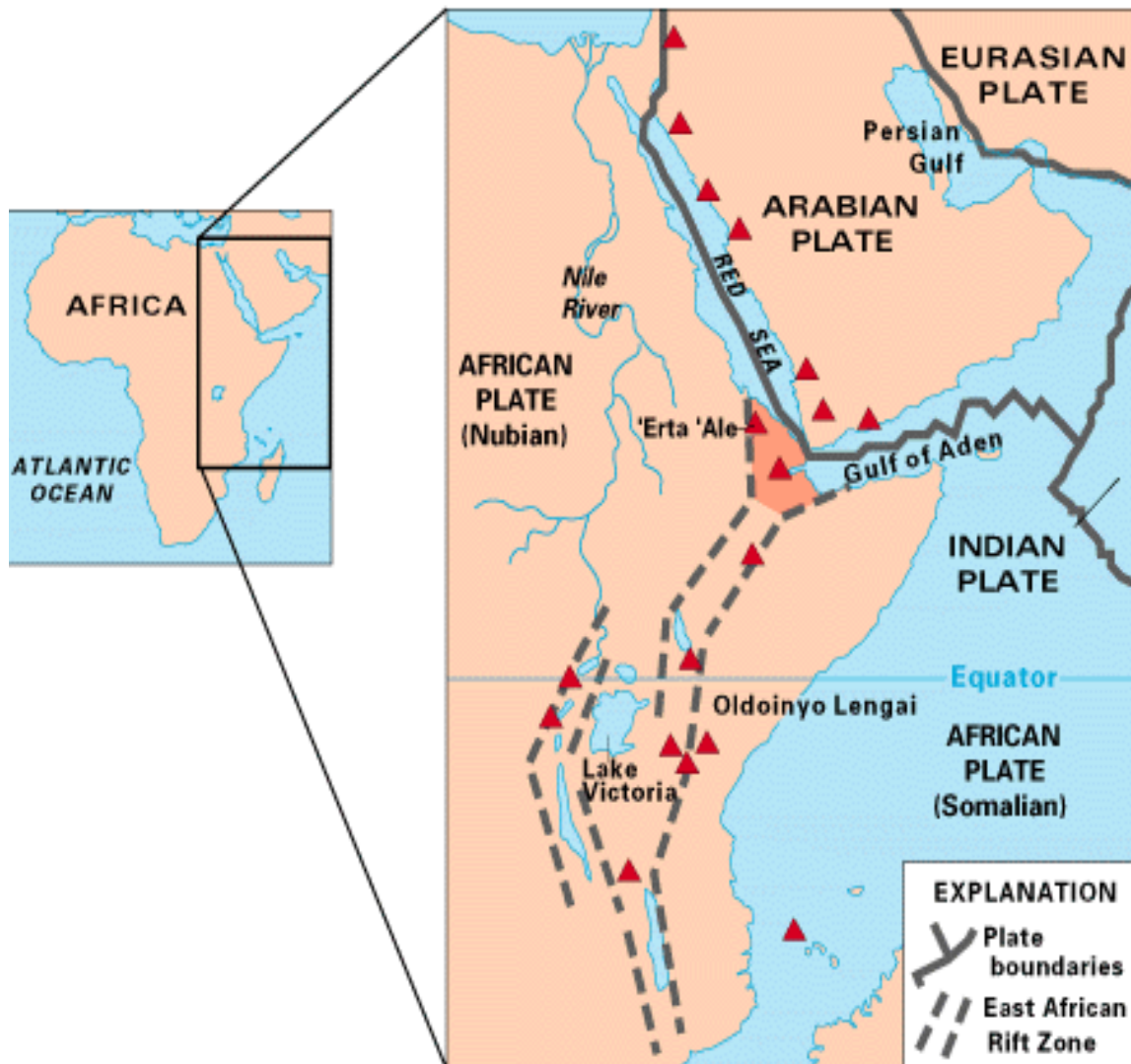
Trench one of the most important natural boundaries on the Earth's solid surface: the one between two lithospheric plates



transform fault also known as conservative plate boundary, is a type of fault at the margin of a tectonic plate whose relative motion is horizontal in either sinisterly or dextral direction. Typically, some vertical motion may also exist, but the principal vectors in a transform fault are oriented horizontally. Not all faults are transform faults, and not all plate boundaries are transform faults. Most transform faults are found on the ocean floor, where they often offset active spreading ridges to form a zigzag plate boundary. However, the best-known transform faults are found on land



:Theory



Map of East Africa showing some of the historically active volcanoes (red triangles) and the Afar Triangle (shaded, center) -- a triple junction where three plates are pulling away from one another: the Arabian Plate, and the two parts of the African Plate (the Nubian and the Somalian) .splitting along the East African Rift Zone (USGS)

three intersect is a seismically active F-F-T triple junction called the Mendocino Triple Junction

The Amurian Plate, the Okhotsk Plate, and the Philippine Sea Plate is another triple junction where mount Fuji is located at an old triple junction of three former continental plates of the Palaeozoic era: Avalonia, Laurentia and .Baltica

:Case study

The junction of the Red Sea, the Gulf of Aden and the East African Rift centered in the Afar Triangle is an example of a triple junction (the Afar Triple Junction). This is the only Ridge-Ridge-Ridge triple junction above sea level

Another example of a triple junction is the junction between the Arabian Plate, the African Plate, and the Indo-Australian Plate

Another active example is the Galapagos Triple Junction, an R-R-R triple junction where the Nazca, the Cocos, and the Pacific Plates meet. The East Pacific Rise extends north and south from this junction and the Galapagos Rise goes to the east. This example is made more complex by the Galapagos Microplate which is a small separate plate on the rise just to the southeast of .the triple junction

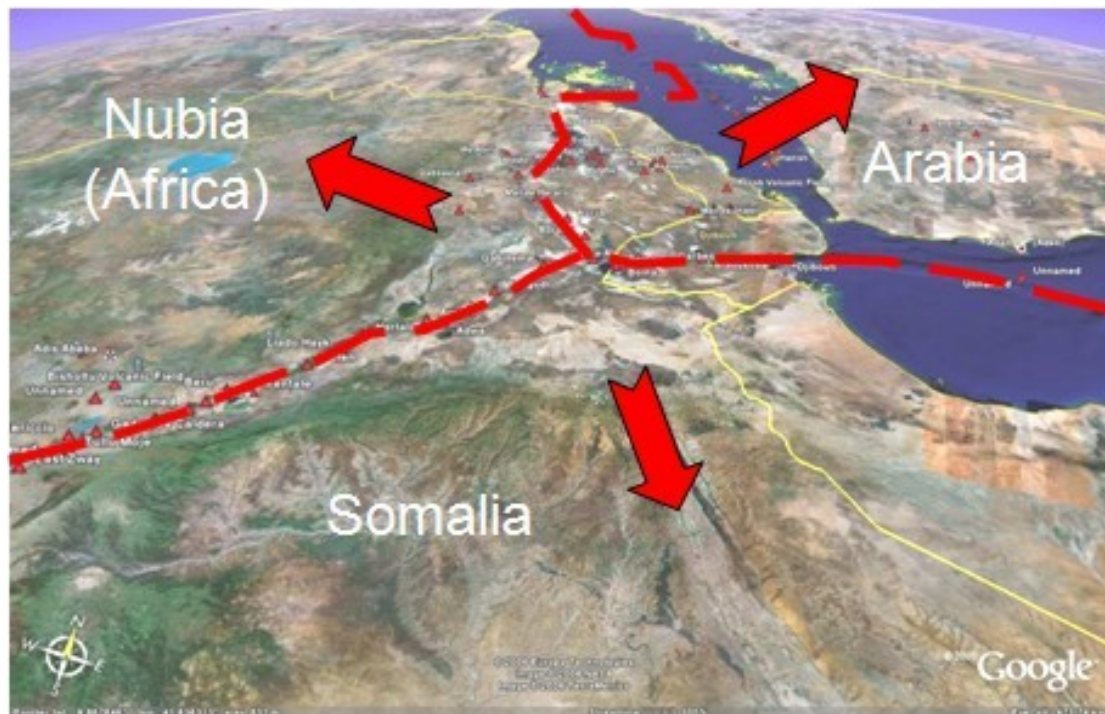
The Red Sea is a seawater inlet of the Indian Ocean, lying between Africa and Asia. The connection to the ocean is in the south through the Bab el Mandeb strait and the Gulf of Aden. In the north, there is the Sinai Peninsula, the Gulf of Aqaba, and the Gulf of Suez (leading to the .Suez Canal). The Red Sea is a Global 200 ecoregion



Gulf of Aden is located in the Arabian Sea between Yemen, on the south coast of the Arabian Peninsula, and Somalia in the Horn of Africa. In the northwest, it connects with the Red Sea through the Bab-el-Mandeb strait, which is about 20 miles wide. The waterway is part of the important Suez canal shipping route between the Mediterranean Sea and the Arabian Sea in the Indian Ocean with 21,000 ships crossing the gulf annually.[1] The gulf is known by the nickname "Pirate Alley" due to the large amount of pirate activity in the area



East African Rift is an active continental rift zone in eastern Africa that appears to be a developing divergent tectonic plate boundary. It is part of the larger Great Rift Valley. The rift is a narrow zone in which the African Plate is in the process of splitting into two new tectonic plates called the Somali Plate and the Nubian Plate, which are subplates or protoplates. It runs from the Afar Triple Junction in the Afar Depression southward through eastern .Africa



Discussion:

Before the continent was called Pangaea, all the continent were attached together until the plate broke into pieces .due to the plate tectonic

Plate tectonic is a movement of the plate below the surface of the earth. There are three type of plate movements convergence plate, , divergent plate and Transform boundary

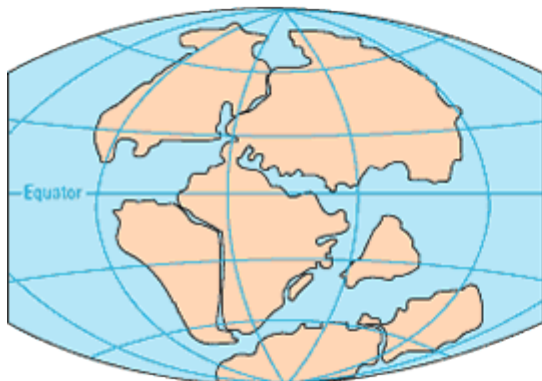
When three of the plate meet at one point we refer to it as triple junction. When triple junction occurs ridges, trench .and transform faults are formed



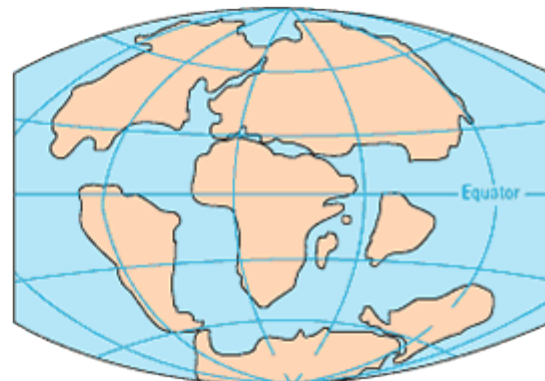
PERMIAN
225 million years ago



TRIASSIC
200 million years ago



JURASSIC
135 million years ago



CRETACEOUS
65 million years ago



PRESENT DAY

this is continental drifting of Pangaea

Conclusion:

Plate tectonics is an expression of the convective regime in the underlying mantle, but the link between individual convection cells and plate boundaries is not direct because plate boundaries are not fixed and, like the plates, move relative to one another. Plate movements are driven by gravity, largely by cold, dense lithospheric slabs pulling younger lithosphere towards a destructive boundary. A less-powerful driving force is generated by the potential energy of spreading centres, elevated some 2–3 km above the general level of the abyssal plains.

As ideas concerning plate tectonics have evolved since the 1970s, it has become apparent that while the theory can be applied vigorously to the oceans, the same cannot be said of the continents. Because of the strength and rigidity of oceanic plates, deformation is focused into narrow linear zones along plate margins. By contrast, when continental lithosphere approaches a plate boundary, deformation can extend hundreds of kilometres into the continental interior because continental plates are less strong. Such deformation gives rise to the major mountain belts of the Earth, as exemplified by the Alpine Himalayan Chain.

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